# ADMINISTRATION REPORT OF MILITARY WORKS

OF THE

## PUBLIC WORKS DEPARTMENT,

BOMBAY PRESIDENCY,

133362

FOR THE YEAR

1885-86.

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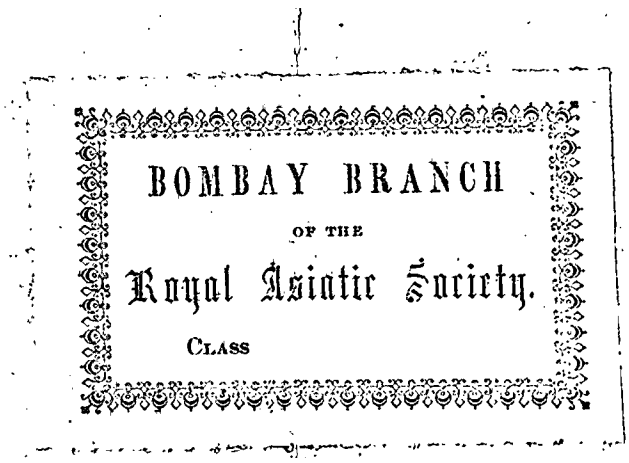


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## MILITARY WORKS.

1. The places within the limits of the Bombay Presidency at which Bombay Troops are stationed, and the buildings in which are in the charge of the Bombay Public Works Department, are as follows :—

| Army Division or District. | Name of Station. | Executive District. | Superintending Division. |
|---|---|---|---|
| Northern Division of the Army ... | Ahmedabad ... | Executive Engineer, Ahmedabad ... | Superintending Engineer, Northern Division. |
| | Rájkot ... ... | | |
| | Bhúj ... ... | | |
| | Baroda ... ... | | |
| | Surat ... ... | Executive Engineer, Surat ... ... ... | |
| Bombay District ... | Bombay... ... | Executive Engineer, Bombay Defences. | |
| | Colába ... ... | | |
| | Thána ... ... | Executive Engineer, Thána... ... ... | |
| | *Devláli ... | Executive Engineer, Násik ... ... ... | |
| Poona Division of the Army ... | Poona ... ... | Executive Engineer, Poona and Kirkee... | Superintending Engineer, Central Division. |
| | Kirkee ... ... | | |
| | Sirúr ... ... | Executive Engineer, Poona District .. | |
| | Purandhar ... | | |
| | Khandála ... | | |
| | Ahmednagar ... | Executive Engineer, Ahmednagar ... ... | |
| | Sholápur ... | Executive Engineer, Sholápur ... ... | |
| | Sátára ... | Executive Engineer, Sátára... ... ... | |
| | Málegaon ... | Executive Engineer, Khándesh ... ... | |
| Sind District ... | Karáchi... ... | Executive Engineer, Lower and Central Sind ... .... | No Superintending Engineer. |
| | Ghizree... ... | | |
| | Hyderabad ... | | |
| | Jacobabad ... | | |
| Aden Brigade ... | Aden. ... ... | Executive Engineer, Aden ... ... | |
| | Perim* ... ... | | |

* Since transferred to Bombay Defences District, under the Superintending Engineer, N. D.

2. In addition to the foregoing stations, the Bombay Public Works Department has in its charge the buildings in the following stations in the Southern Division, now garrisoned by Madras Troops :—

*Belgaum District (Madras Army).*

| | | |
|---|---|---|
| Belgaum ... Kolhápur... | Executive Engineer, Belgaum ... | Superintending Engineer, Southern Division. |
| Dhárwár ... | Executive Engineer, Dhárwár ... | |

3. There is no separate Military Works establishment in this Presidency and the Executive Engineers in charge of the several stations are in charge also of the Civil Works in the neighbouring districts, except in the case of the Executive Engineer, Bombay Defences, whose duties are almost wholly confined to Military Works.

4. This being the first separate Administration Report of Military Works for this Presidency, it was the intention to have given an account in some detail of the stations and buildings in the charge of the Public Works Department, but it has been found that to do so in a complete and satisfactory manner would, perhaps needlessly, delay the submission of the report, and, as now prepared, it comprises merely an account of the operations of the year.

5. A statement is, however, in preparation, and will be issued as an Appendix to this report, showing the particulars of the accommodation available at each station, from which some idea may be formed of the extent of the military buildings, &c., the repair and maintenance of which form no inconsiderable portion of the duties of the Department in relation to military works. A map, in three sheets, showing the various Military Stations, will also be included in the Appendix.

6. Shortly after the commencement of the year, in May 1885, the Government of India in the Military Department intimated to this Government, that, owing to the strain on the finances caused by the military preparations on the North-West Frontier, the Military Works expenditure must be curtailed, and limited absolutely to necessary repairs, new works in progress which cannot be suspended without serious detriment, and Defence Works, and called for a statement of possible savings. This being duly submitted, it was decided that a reduction of Rs. 2,00,000 should be made, which was accordingly done. Of this amount, Rs. 1,31,250 was taken from the grant for Original Works; Rs. 21,350 from that for Repairs; Rs. 37,400 from that for Establishment and Tools and Plant; and Rs. 10,000 from that for the Barrack Department. With the above reduction, and certain subsequent additions, the expenditure under the head Military, including Contributions, in 1885-86 amounted to Rs. 17,60,520, of which Rs. 6,40,074 was for Defence-Works. The balance, Rs. 9,86,833, included Rs. 3,14,062 for Original Works: Rs. 4,78,349 for Repairs: Rs. 1,82,979 for Establishment: Rs. 11,443 for Tools and Plant, and Rs. 1,33,613 for Barrack Department.

7. Following the usual course, the operations of the year are described under the several heads laid down in the regulations for the classification of expenditure on military works.

## 1.—ACCOMMODATION FOR TROOPS.

### Buildings for European Troops in the Plains.

Bombay Defences. New Barracks at Colába.

8. For many years past, the construction of permanent barracks for the European Troops at Colába, has occupied the attention of Government. Many schemes have been under consideration since the 6 semi-permanent barracks were erected in 1876-77, on the permanent plinths originally built in 1869-70.

9. The project which has now been approved of by this Government, and sanctioned by the Government of India, entailing an outlay of Rs. 8,97,259, comprises an addition of 2 new upper-storied blocks of permanent barracks, with out-buildings, on either flank of the existing 6 semi-permanent barracks, and the construction of similar barracks on the existing permanent plinths.

10. The building area of Colába, being restricted to the high narrow ridge, necessitates this arrangement.

11. Each upper-storied barrack block will accommodate 4 sergeants and 72 rank and file, and is designed on the latest principles, from standard type drawings modified to suit the Bombay climate.

12. During the year under observation, the site of the south flank barrack has been opened up, by the removal and reconstruction of 2 skittle alleys and 1 plunge bath in the Morley Hall Estate, at an expenditure of Rs. 12,902.

Ahmedabad.

13. The Station Hospital for European Troops at Ahmedabad, commenced in 1881, is not as yet complete, though it has been occupied since August 1885. It is an upper-storied building, with accommodation for 24 beds. The chief work that remains to be done is the arrangement for the water-supply. During the past year a large well has been excavated, which supplies good water. A water tower near has been built up to tank level, but pumps and piping have to be procured from England.

14. In proximity to the main building is the female hospital, with accommodation for 6 beds, occupied in August 1885, besides a guard-room, cook-house, latrines, servants' quarters, laundry, and stable, which have all been completed during the past year.

15. Quarters for the Medical Subordinates are provided for in separate buildings, or in the hospitals themselves. The expenditure on the whole of the hospital buildings during the year was Rs. 43,000, and Rs. 4,500 are still required to complete them.

Kirkee (New Jhansi).

16. In consequence of an increase in the garrison of Royal Artillery at Kirkee, it became necessary to move some of the European Royal Engineers, attached to the Bombay Sappers and Miners, out of the quarters which they had previously occupied in one of the Artillery Barracks, and to provide them with fresh quarters. With this intent a portion of a barrack, on the standard plan, was constructed at New Jhansi, with a cook-house and latrine. The portion of building constructed is 35′×28′×16′, with a verandah, ten feet wide, on three sides. A temporary ablution room was made in one corner of the verandah. The actual expenditure incurred was Rs. 7,806.

Devláli.

17. The quarters for Married Officers at Devláli are practically completed; as described in last report, they provide accommodation (two rooms and a bath-room each) for nine officers. A mess-room and subsidiary rooms occupy the centre of the building. A cook-room for the quarters was commenced at the end of the year. The estimate for the quarters amounts to Rs. 42,535, of which Rs. 35,712 were spent to the end of 1885-86.

18. Five small latrines, on the model district plan, were also provided in the officers' compounds at Devláli.

Belgaum. Devláli.

19. A new two-section rifle range for British Troops was completed at Belgaum, and another range was commenced at Devláli in February, and was in progress at the end of the year.

Perim.

20. The Officers' quarters on the Island of Perim were added to and enlarged at a cost of Rs. 3,898: the work was completed in July 1885, for the accommodation of the Officer in charge of the Detachment of Native Infantry, who has been entrusted with the civil duties entailed by the establishment of a Coal Company on the island.

BUILDINGS EXPECTED TO YIELD A RETURN ON THEIR OUTLAY.

Bombay Defences. Bombay.

21. New permanent quarters for Officers in the Marine Lines, Bombay, comprising two blocks to accommodate four Field Officers, or eight officers below that rank, with servants' quarters, stables, &c., have been in progress during the year. The unit in these quarters will be as under, *viz.*:—

I.—A half block complete with out-houses for an officer of field rank.

II.—The first floor of half block, with proportion of out-houses, for a Captain.

III.—The ground floor of half block, with proportion of out-houses, for a Lieutenant.

22. A Subaltern's unit, on the ground floor, consists of two main rooms, one 22′×18′, and the other 20′×18′, with an arcade on the west, and an open verandah on the east side. The centre portion of the block is appropriated for the staircase, a godown, and a dispense room. Terraced porches have been provided to the quarters on both ends of the blocks.

23. The first floor, or Captain's unit, has also two rooms, one 22′ 4½″×18′ 6″, and the other 20′ 6″×18′ 3″, having bath and dressing rooms, with an open verandah, both on the east and west sides, protected by cast-iron railings.

24. The full complement of servants' quarters, laid down in paragraph 9, section 3 of the Bombay Barrack Regulations, has been provided, to preclude any claim for rent for inferior quarters by a Colonel, Lieutenant-Colonel, or Surgeon-Major.

25. The out-houses to one-half block consist of one block for in-door servants, comprising six rooms and one kitchen, and one block for out-door servants and stables, comprising six rooms, four stalls and one coach-house. Up to the 31st March 1886, the masonry of both blocks of the main buildings was completed to the top of the cornice, and in one block was carried up 2 feet high on the first floor.

26. The servants' houses, stables, latrines, and covered passages were nearly completed.

27. The total expenditure has been Rs. 83,202, against the sanction of Rs. 1,28,941.

28. The Municipal authorities having brought their sewerage system into the immediate locality of the Marine Lines, Bombay, the Government approved of a project, the cost of which is estimated at Rs. 13,244, for connecting the Officers' bungalows and the Regimental buildings with the Municipal sewers. The scheme was approved of by the Sanitary Commissioner, and the Health Officer of the Municipality, and consists of a complete system of glazed stoneware pipe sewers, with the necessary manholes and ventilators, syphon traps, &c., which will provide thoroughly for the sewerage of all the Government buildings in this locality.

Aden.

29. In 1881 the want of accommodation for the Officers of the two Batteries at Steamer Point was represented, and in connection therewith a proposal was made to build new quarters and an office for the Brigade Major, the intention being that the house then allotted to that officer should be used for two officers of the garrison. No funds were, however, available, and the project remained in abeyance until October 1884, when it became necessary to arrange to proceed with the building, as the house occupied by the Officer Commanding the Royal Artillery stood upon ground required for the new Fort at Tarshyne. The quarters comprise a drawing and dining-room (with pantry 14′ × 7′), each 26′ × 18′, two bed-rooms, one 18′ × 18′, with bath-room 12′ × 5½′, and the other 18½′ × 13′, with bath-room 9½′ × 8′. A verandah, 9 feet wide, runs in front of the drawing-room, dining-room, and larger bed-room, and another, 7 feet wide, runs past the back of the dining-room. The out-houses comprise a cook-room, including cook's quarters and four quarters for servants, besides a coach-house and stabling for two horses, and quarters for two grooms.

30. The office is detached, and comprises four rooms, with a verandah on two sides.

31. The buildings, though not quite complete, were occupied in October 1885. They will cost, when completed, Rs. 19,283, including approach roads, which were expensive, as the main building is on a spur 80 feet above the plain.

### Buildings for Native Troops.

Karáchi.

32. Quarters have been completed at Manora in the year under report, at a cost of Rs. 14,923, for the accommodation of the Native Officer (1), Non-Commissioned Officers and men (24 married and 26 unmarried), of the Sappers and Miners employed in Sub-Marine Mining Defences of the Port of Karáchi. The pendalls also afford accommodation for the khalásis employed in the Torpedo steam launch and Royal Artillery Defences cutter. The scale of accommodation is as follows:—

| | | |
|---|---|---|
| Married Non Commissioned Officers... | 170 | Square feet. |
| „ men ... ... | 100 | „ „ |
| Unmarried do. ... ... | 75 | „ „ |
| Khalásis ... ... ... | 72 | „ „ |

33. No other buildings were in progress under this head.

## 2.—ORDNANCE WORKS.

Bombay Defences, Bombay.

34. An isolated magazine, for the storage of dry gun cotton, has been constructed at Siwri, on a plateau 290 feet to the north of Siwri Magazine. 600 lbs. of dry gun cotton can be stored. The building is provided with a lightning conductor; the whole costing Rs. 691.

Ahmedabad.

35. No further progress was made with the new Ordnance Dep't at Ahmedabad. It was stated in the report for last year that work on the gun-shed for the heavy battery had been suspended. It was subsequently decided that it was not required, and that the only further buildings necessary were a small office and quarters for one Warrant and one Non-Commissioned Officer. The estimate has been revised accordingly, and now amounts to Rs. 1,20,032, as compared with Rs. 2,41,134, the amount of the original scheme. The total expenditure has been Rs. 1,06,271, leaving Rs. 13,760 required to complete the project.

Kirkee.

36. In the Small Arms Ammunition Factory the following works were undertaken:—

I.—The hand operation room was enlarged at a cost of Rs. 27,761, exactly doubling its former capacity, by adding a room, 100′ × 25′, on the west side of the old room.

II.—The lead-squirting room was enlarged at a cost of Rs. 3,490, by adding a room, 26′ × 29′; a considerable item in the cost being provision of an extra strongly laid paved floor, with extra fine joints, as it was found in the old building, that the rollers on which the lead is wound, in the operation of lead squirting, got into the joints of the paving, and very soon ruined the floor surface.

III.—The verandah of the soldering room was enclosed, at a cost of Rs. 1,988, by glazed shutters (capable of being opened if necessary) to exclude the rain and dust, and give increased accommodation in cases of emergency.

IV.—An inner store-yard was constructed, at a cost of Rs. 15,795, by enclosing, with a high masonry wall, a rectangular space 210′ × 165′, and constructing lean-to sheds on the inner sides of the enclosure; the ends of two of the sheds being further enclosed to form two rooms, 25′ × 18′ and 15′ × 18′, respectively, for storing oils and acids.

V.—Additional skylights were provided, at a cost of Rs. 5,172, to the machine-room, by opening the roof on the north side, and inserting glazed shutters, which have been found to be a great improvement on the original arrangement, and now give all the light which is required for the efficient working of the machinery.

37. In the Gun Carriage Factory at Poona:— Poona.

I.—A new shed for half wrought timber, 128′ × 30′, sheltered on the west side by a verandah, 6 feet wide, was built against the boundary wall on the east side of the Arsenal—an ordinary shed, covered with Mangalore tiles, supported on queen post trusses, the cost of which has been Rs. 5,260.

II.—A timber shed, 120′ × 30′, was constructed, at a cost of Rs. 6,424, the roof covering of Mangalore tiles, on teak queen post trusses; the two ends gabled, resting on masonry walls; the sides open; masonry pillars supporting the trusses.

III.—An open shed, 168′ × 32′, was built, at a cost of Rs. 5,796, to serve as a carpenters' workshop—a plain Mangalore-tiled roof, on teak trusses, which again are supported on teak posts.

38. In the cold weather of 1885, the Karáchi Arsenal was inspected by the Director General of Ordnance, who reported that the buildings were quite insufficient for the wants of the establishment. The importance of this Arsenal has greatly increased of late years, and is likely to grow still further, as the place is a secondary base of supply between the Bombay Arsenal and Beluchistán. Under the orders of the Government of India, issued in consequence of the Director General's inspection, the following additions and alterations were undertaken during the year:— Karáchi.

*Pattern-room.*—A room, measuring 63′ × 20′, has been erected over the store-room for this purpose, at the south side of the entrance of the Arsenal polygon. It has a sun-shade verandah on the west side, 7 feet wide. Completed.

*Store-rooms.*—Three new store-rooms have been built—one measuring 178′ × 23½′, for the storage of a field battery; another, 88′ × 23½′, for small stores; and the third, 25′ × 23½′, for a rope godown. The roofs are supported on masonry pillars, the intervening spaces being filled in with cut teak trellis-work, provided with doors. The floors are paved with stone. Completed.

*Shed for Khujawas, Carts, &c.*—A shed, measuring 100′ × 25′, with a flat lean-to roof, has been constructed against one of the walls forming the Arsenal polygon. The roof is of corrugated iron, supported by posts and iron girders. The front wall is provided with teak trellis doors, opening outwards, the ends being closed by masonry walls. Completed.

*Timber shed.*—This shed measures 131′ × 26′, and has been constructed in the north-west angle of the Arsenal enclosure. It has a corrugated-iron roof, and was nearly completed during the year.

*Armourers' Workshop.*—This building is in accordance with the standard design, and consists of two rooms, one 30′ × 30′, and the other 30′ × 15′, with a verandah 10½ feet wide. The work was about half completed during the year.

*Guard-room* at the entrance gate. The room measures 24′ × 18′, with a verandah, 7½ feet wide, all round, and is about half completed. It is situated in proximity to the future main entrance to the Arsenal.

39. The entire outlay during the year on these additions amounted to Rs. 23,094. The other works considered necessary to meet the requirements of this Arsenal will be undertaken in 1886-87.

## 3.—COMMISSARIAT BUILDINGS.

Belgaum.

40. The only major works in progress during the year under this head were temporary buildings for slaughteries for the Commissariat Department at Belgaum. The cost was Rs. 5,258, and was provided by the Southern Marátha Railway Company, the site on which the old slaughteries stood having been taken up for the railway. The question of new permanent slaughteries is under consideration. A new well, 12 feet in diameter, and 57 feet deep, to laterite rock, to afford a supply of water to the slaughteries, was sunk. The cost was Rs. 3,718, of which Rs. 2,093 was paid by the Railway Company, and the balance by Government.

## 7.—GENERAL CANTONMENT WORKS.

### Water-supply.

Aden.

41. The new condenser building at Steamer Point, Aden, referred to in last year's report, was completed during the year, except a portion of the feed pipe to lead water into the intake well, which was delayed, as it can only be proceeded with during low water spring tides. The outlay in 1885-86 was Rs. 8,490.

## 8.—FORTIFICATIONS.

Bombay Defences. Bombay.

42. The scheme for the Defences of Bombay, as first drawn out, consisted in providing emplacements for some heavier guns in the various batteries, with additional magazines and other subsidiary buildings, as required for the new armament; the re-arming of Cross Island Battery; and the construction of a new subsidiary battery at Colába Point, in addition to the existing one. The scheme provided for the gun emplacements on the several batteries, and five magazines, and ten shell or cartridge stores, and three bombproof covers at the different batteries, with several store-rooms and other accessory buildings; the filling up and finishing off the island at Middle Ground with stone debris, and the demolition of Fort George, clearing the site, and utilizing the material, as far as possible, in the various works.

43. The total estimated cost was Rs. 3,66,000, of which Rs. 1,10,360 were expended during the year.

44. Since commencing the work, the scheme has undergone constant alterations, and a final revised scheme is shortly expected, consequent on the inspection, on the 8th March 1886, by His Excellency the Commander-in-Chief in India, accompanied by other distinguished officers. In the meanwhile, work has been carried on, as far as possible, in anticipation of the proposed changes. The chief points of the new scheme are the greater spaces, with traverses between guns, and the consequent lessening of the number of guns in some of the batteries; greater thickness of parapets, and detached emplacements for guns.

Construction.

45. As regards construction, stone masonry, in cement or lime, is used almost wholly throughout. The bombproof roofs of magazines, &c., are carried on teak beams and planking, and consist of a total thickness of 5′ 6″ of cement and lime concrete, with earth on the top. The foundations of the gun emplacements below the drum platforms have a minimum depth of 5 of solid concrete; in most cases more.

46. The progress made in the different batteries is as follows :—

Colába Point Battery.

One gun emplacement nearly complete, and ready for fitting on the platform, before finally adjusting the racers. The second emplacement is more than half finished. Shell-room up to roof beams.

Subsidiary Battery, Colába.

This battery has not been commenced, as the question of its being constructed or not was under consideration.

Oyster Rock Battery.

One shell-room and one bombproof up to roof beam; second shell-room and magazine commenced; a number of emplacements of existing guns removed; both emplacements, of heavy guns, are in hand, but as very extensive alterations have been made, work

in general has been much delayed, and these two emplacements have had practically to be totally recommenced during March, owing to increased thickness of parapet.

Middle Ground Battery and Filling.

The filling-in work is nearly complete. The landing stage and boat basin are well advanced.

Cross Island Battery.

The heavy gun emplacement is well forward; one gun emplacement is nearly complete. The landing stage for heavy guns is finished. The change of armament has delayed the work here.

Mahálakshmi Battery.

Gun emplacement is nearly ready for the fitting of the platform; the extension of parapet is complete; and magazine foundations are all in.

Malabar Point Battery.

Most of the rock excavation for heavy guns, and extension of battery, is finished. Work has been suspended here since the 30th December 1885, during the residence of His Excellency the Governor at Government House, Malabar Point.

Fort George Demolition.

The whole Fort is practically down, but the ground is not yet cleared. Most of the material has been used in the Middle Ground filling, and some of the stones in the batteries.

47. In connection with the above works, the Royal Artillery has been occupied in conveying to the sites some of the guns, of which two are lying in Colába Battery, and some of the dismantled 9″ guns at Oyster Rock have been taken away.

Ahmedabad.

48. At the south-east corner of the Cantonment, a fortified post, consisting of a wall and ditch, enclosing a square of 200 yards sides, with bastions at two corners, was commenced in 1884-85. Within the square a large magazine and buildings for Commissariat stores have been completed, and the latter occupied.

49. It is intended also to provide within it quarters for Ordnance and Commissariat subordinates. The expenditure on this work during the year was limited to Rs. 10,000.

Karáchi.

50. This work was intended for the defence of the gorges of Nos. 1 and 2 Batteries at Manora.

Improving Batteries Nos. 1 and 2 at Manora.

51. In No. 1 Battery the work consists of a loop-holed wall, across the gorge, in two portions; the bungalow at present occupied by the Port Officer being intended to constitute a block-house, connecting the two portions. The wall is 10 feet high, with a banquette inside, 2 feet high, with horizontal type loop-holes, the sills of which are 4′ 3″ above the banquette, and are placed at intervals of 6 feet apart. Access to the interior of the battery is procured by means of 2 gates, 12 feet wide, constructed of ¼ inch iron plate, loop-holed.

52. In No. 2 Battery the loop-holed wall is in all respects similar to the above, but 2 block-houses, loop-holed for 18 and 16 rifles respectively, have been constructed, so as to secure a flanking defence. The loop-holes in this battery are partly of the horizontal, and partly of the vertical, type, the sills of those of the vertical type being 4 feet above the banquette. Two gates have also been provided in this, as in No. 1 Battery, and all the walls are protected by a coping of broken glass in lime.

Completing No. 3 Battery and other Defences at Manora.

53. This work has been in abeyance throughout the year, pending the receipt of revised plans for its construction from the Defence Committee. An expenditure of Rs. 23,095 has been incurred for teakwood and stone collected for future use.

Constructing Blindages, &c., at Manora, in connection with the Defences at Karáchi.

54. This work has been in abeyance pending the receipt of new plans from the Defence Committee at Simla.

55. Materials, consisting of teakwood to the value of Rs. 1,096, have been collected, and a causeway from No. 3 Battery to the site of a future blindage, on the other side of a lagoon, has been constructed of sand and mud. A timber bridge of 2 spans, each 9 feet wide, to give access to the tide, has been constructed so as to be capable of being removed or destroyed in the event of the guns from the blindage in question having to be retired suddenly.

Protection of Manora Point.

56. The further protection of the west or sea face of Manora Point, as recommended by the Defence Committee, and of which the design and estimate, amounting to Rs. 1,09,943, submitted by the Port Engineer, Karáchi, were sanctioned in 1882, was provided for by an allotment in 1885-86, and was taken in hand as soon as the south-west monsoon sea had subsided, in October 1885.

57. The changes which had taken place in the cliff since the original design was prepared, and the requirements of the Defence Committee as regards a scarp of 20 feet, rendered necessary a revision of the design and estimate, involving, however, no increase of the total amount.

58. During the working season the most difficult part of the work was completed, being the row of massive concrete blocks, varying from 100 to 200 tons each, formed in cofferdams, and extending for a length of 220 feet.

59. At the back of this was put in a layer of rubble stone and concrete, extending to the inner tier of concrete, and rubble blocks, of 100 tons each, built "in situ," at a slope of 3 inches to a foot, of which the lower row of five blocks, and four of the second row, were completed by the 31st March, and the remainder of the three rows was completed by the end of the season; so that the base of the cliff at that part is now well protected, leaving the scarp walling, for the protection of the upper part, to be completed next season.

60. It was necessary at first to cut a ramp, 15 feet wide, in the conglomerate rock, for conveyance of plant and material from the top of the cliff to the work; but the supply of material was afterwards aided by the sanction given to the cutting of the ditch across the Point, this partially replacing the quarry on the east face, of which the working was stopped by defence requirements.

61. The expenditure to 31st March was Rs. 42,613.

62. The usual ordinary repairs were done to the first portion of the cliff protection work, completed in 1881-82, which stands well.

Special Repairs to Stone-facing along east side of Manora Point.

63. The extraordinarily high tides, with heavy sea, of June last, having considerably damaged the facing of loose rubble stone along the east side of Manora Point, the special repair of the portion forming the frontage of the Sub-Marine Defence buildings and ground was sanctioned in January last, at an estimated cost of Rs. 3,540, of which Rs. 1,002 had been expended in laying of a temporary railway line, and quarrying and deposit of large rubble, up to 31st March.

64. The work is still in progress, and the most essential part will be completed before the coming south-west monsoon.

Aden Defences. Aden.

65. The work on the new fortifications, Ras Morbat and Ras Tarshyne, alluded to in the report for 1884-85, has progressed steadily, and at the close of 1885-86 their state was as follows, *viz.*:—

Fort Morbat. Rock Excavation.

| *Items.* | *Approximate Amount.* | |
|---|---|---|
| Ditch-work ... | ... Half completed. | Of their respective roughly estimated quantities. |
| Magazines and passages | .. Four-fifths do. | |
| Emplacements | ... One-third do. | |
| Caponiers ... | ... One-eighth do. | |
| Parades ... | ... One-third do. | |

Masonry.

66. Passages about one-half completed, and the same progress made with magazines for medium guns. Escarp and counterscarp walls of front ditch may also be considered as about one-half completed.

Fort Tarshyne. Excavation in Rock.

| | |
|---|---|
| Gorge, east ditch ... | Nearly completed. |
| Do. west do. ... | |
| Caponier ... ... | Completed. |
| Scarping shore lines ... | Nearly half completed. |
| Old Fort ... ... | Nearly completed. |
| Gorge work ... | About three-fourths carried out. |
| Main Battery ... | Nearly completed. |
| Casemate Battery ... | |
| Musketry emplacement... | About half done. |
| Main Magazine ... | Complete. |

Masonry.

| | |
|---|---|
| Gorge, east ditch ... | About three-fourths finished. |
| Do. west do. ... | Nearly complete. |
| Caponier ... ... | Complete, except cement concrete roofing. |
| Old Fort ... ... | Nearly complete. |
| Gorge work ... | About half completed. |
| Main Battery ... | Only small drain carried out. |
| Casemate Battery ... | About three-fourths complete, but cement concrete roof not commenced. |

Telegraph Bay Battery.

67. This battery was commenced early in the official year, partly by contract, and partly by Sapper labour, but was abandoned shortly afterwards, on the Company of Sappers being sent on duty to the African Coast, and not resumed again till about November 1885. As the original estimate provided only for materials, and not labour, an entirely new estimate was framed, amounting to Rs. 19,120. This battery is for 4 guns, with three magazines, one small arms store, and eight ammunition recesses. The emplacements of two of the guns could not be carried out owing to the non-receipt of racers from the Bombay Arsenal, and the road of approach had not made much progress; otherwise the work was completed.

68. The expenditure on the three fortification works noted above has been as follows in 1885-86 :—

| | | |
|---|---|---|
| Fort Morbat ... ... ... ... | Rs. | 1,39,065 |
| Fort Tarshyne ... ... ... ... | ,, | 1,53,831 |
| Telegraph Bay Battery ... ... ... | ,, | 12,719 |

## 9.—DOCKYARD AND NAVAL BUILDINGS.

Bombay.

69. The Dockyard, situated between the Custom House and the Apollo Bandar, covers an area of about 135,000 square yards, and contains five graving docks, which are constructed so as to make two large docks. They are placed alongside each other. The three oldest docks are called *The Upper Old Bombay Dock, The Middle Old Bombay Dock, The Lower Old Bombay Dock*, and the two later ones are called "*The Duncan Docks.*"

70. Alongside the docks is the steam factory, a building 405 feet in length, 46 feet in width, and 42′ 6″ high, which contains, besides a foundry, all the machinery requisite for making boilers and every portion of the fittings of a marine steam engine.

71. There are, besides, in the yard godowns for the accommodation of all descriptions of marine stores, ship-building sheds, and a pumping engine-shed, recently erected; buildings for the offices of the Indian Marine, the Marine Storekeeper, the Dockyard Accountant, the Staff Officer, the Constructor, the Marine Surveyor, and other officers employed in the yard; there are also residences for the Director of the Indian Marine, the Boatswain, the Inspector of the Yard, the Inspector of Police, and Lascars, and various other buildings.

72. The following are the operations of the year under this head :—A range of existing upper-storied godowns, abutting on to Apollo Street, is being extended 60 feet in length on the north side, and 100 feet on the south side, in order to provide additional accommodation for storing the armaments of merchant vessels. The style of construction of the extension is similar to that of the existing godowns. The godowns are 36½ feet wide in the clear, the height of the ground floor being 18 feet 4 inches, and that of the first floor, 15 feet. On the south side of the ground floor of the extension, a room, 36′ × 36′ 6″, is set apart for the accommodation of gun carriages. The estimated cost of the whole extension is Rs. 47,514, of which Rs. 20,960 have been expended during the year, in completing the foundations and plinths, and raising the walls to an average height of 14 feet.

73. A shed for the deposit of transport fittings, estimated to cost Rs. 18,916, was commenced, and completed, during the year, at a cost of Rs. 18,433. The shed measures 171′ 6″ × 51′ 6″ outside dimensions, and is 14 feet high up to the top of the posts; it is open on two sides, and protected on the other two by a corrugated sheet iron fence. The building is covered by an iron roof, supported on teak posts.

74. A shed for the storage of armoured cables, measuring 40′ 8″ in length, and 21′ 6″ in breadth, outside dimensions, and 14 feet up to tie beam, estimated to cost Rs. 2,791, was commenced, and completed during the year. It is enclosed by corrugated-iron sheets, and covered with a roof of the same material, supported on posts. A small room, for storing testing apparatus, 7′ × 3½′, has been formed, in one corner of the shed, by teak planked walls. A pit, 37′ 3″ × 13′ 3″, to receive two iron tanks, 15′ × 10′, has been made in the ground, 4′ deep, and lined with masonry walls. A hydrant, with all necessary pipes for filling in the tanks, has been provided, and an underground pipe laid for the conveyance of waste water from the tanks into the sea. The actual cost of the building has been Rs. 2,473.



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